B.C. Hydro

Stikine-Iskut Hydroelectric Development

Environmental Studies in Alaska

October 1982

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ENVIRONMENTAL STUDIES IN ALASKA

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PREFACE

This report describes B. C. Hydro's environmental studies conducted on the Stikine River in Alaska which are part of detailed investigations undertaken to examine the hydroelectric potential of the Stikine and Iskut rivers.

B. C. Hydro has not as yet decided whether or not to seek regulatory approval for hydroelectric developments in the Stikine-Iskut basin and such a decision will be made only after completion of studies designed to identify specific development costs and effects.

Although they would be 70 to 150 miles upstream of the mouth of the Stikine, the proposed impoundments on the Iskut and Stikine rivers could result in flow and water quality changes in the Alaskan floodplain and estuary. Consequently, B. C. Hydro is committed to:

1. investigate in detail the potential effects of downstream flow and water quality changes;

2. design a program of power generation which will, as far as reasonably possible, minimize downstream impacts;

3. make information available to government agencies and the public in Alaskan communities near the mouth of the Stikine River.

For further information about the proposed Stikine-Iskut development, please contact the Community Relations Department, B. C. Hydro, 970 Burrard Street, Vancouver, B. C. V6Z 1Y3 or telephone (collect) 663-2405.

1.0 INTRODUCTION

The Stikine River rises on the Stikine plateau in northwestern British Columbia, flows a distance of some 300 miles to the B. C.-Alaska border and a further 20 miles through the Alaska panhandle to the delta near Wrangell, Alaska. The Iskut River is the largest tributary of the Stikine and discharges into it approximately 7 miles upstream from the B. C.-Alaska border (see Fig. 1).

Engineering and environmental overview studies carried out for B. C. Hydro in 1977 found that, based on preliminary data, the Stikine-Iskut development appeared to be technically feasible and economically attractive. Hydroelectric development of sites on the Stikine and Iskut rivers would add approximately 2800 MW of installed capacity and approximately 15 000 GW.h of average annual energy capability to Hydro's integrated system[1]. The Iskut River represents about one-third of this potential. Studies to obtain further engineering and environmental information on the projects started in 1978 and are being carried out by Hydro staff and consultants.

The development plan being considered envisages two dams on the Stikine, at the Stikine Canyon and Tanzilla sites, and two in the Iskut basin, at Iskut Canyon and More Creek, as well as a diversion dam on Forrest Kerr Creek to provide additional water for generation at the More Creek site.

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[1] Capacity is the rated output power of a generating station, measured in megawatts (MW). One megawatt equals one thousand kilowatts, or one million watts. Energy capability is the amount of energy a generating station can produce in a given time, measured in gigawatt-hours (GW.h). A gigawatt-hour is a unit of energy equal to that expended at the rate of one million kilowatts for one hour.

The proposed dams on both the Stikine and Iskut would be above salmon migration runs. Impacts on salmon therefore would be limited to those which might be caused by flow regulation and/or water quality changes. Studies carried out to date indicate that, without mitigation, there could be some adverse effects on the salmon. However, preliminary assessment suggests that mitigation measures at reasonable cost could protect fish runs from many of the negative effects.

Development of the Stikine would reduce the scenic appeal of the upstream portion of the Grand Canyon, between the Tanzilla site and the head of the canyon near Highway 37. Two reaches would be partially submerged by the reservoirs and one reach would become dry because river flows would be redirected through a power tunnel to the downstream powerhouse. However, improved access would provide greater opportunity for the public to view the Grand Canyon and use its recreational potential. No communities would be flooded by the development.

Should B. C. Hydro decide to seek regulatory approvals to construct the Stikine-Iskut projects, it is likely that the proposal would be subject to extensive review procedures; for example, a review by public hearings before the B. C. Utilities Commission.

It is estimated that engineering and environmental studies required for a decision by B. C. Hydro to seek regulatory approval will not be complete before 1984. This means that the earliest possible in-service date for the first Stikine-Iskut project would be October 1993.

2.0 DESCRIPTION OF COMPLETED STUDIES IN ALASKA

B. C. Hydro biologists and consultants first began studying the Stikine estuary and floodplain in 1978. It was realized then how vast and biologically unknown the river was. In addition, an investigation of records of the commercial salmon fishery indicated a general decline in fish catches over the previous 50 years (Fig. 2). Therefore, when designing the program of studies, B. C. Hydro concentrated on selected environmental variables and processes to ensure useful data were collected in the time available before application.

Moreover, the need to study fish habitats and limits to fish populations was recognized as being at least as important as studying present fish numbers.

All data existing in 1978 on the biophysical components of the estuary and lower river were collected for B. C. Hydro by Schultz International Ltd. The major objective of the literature-based study was to assemble and analyze aquatic and terrestrial habitat data that would be needed to evaluate the impacts associated with the proposed upstream hydroelectric developments, and to identify gaps in the data.

The Schultz study concluded that: " ... little baseline information exists, either published or in files of regional biologists, pertaining to aquatic biology, hydrology and many components of the terrestrial environment of the Stikine estuary and Alaskan segment of the river". The major data gaps identified related to:

1. bedload (gravels and sands moving along the bottom of the stream) transport in the lower river as it effects delta formation;

2. structures and function of the delta (including oceanography, estuarine circulation, deposition and erosion);

3. marsh and floodplain habitats for birds and mammals;

4. species, abundance and utilization of food organisms in the estuary (including suspended and bottom organisms);

5. locations of critical habitats for salmon, eulachon, starry flounder and other important food fishes;

6. principal rearing areas, relative abundance and growth stages of juvenile salmon.

With the above data deficiencies in mind, terms of reference for detailed estuary and floodplain studies were prepared by B. C. Hydro and Beak Consultants Limited was retained in the fall of 1979 to undertake the required work.

Beak remains B. C. Hydro's principal consultant for Alaskan environmental studies and has identified and completed several investigations, which were considered to be essential additions to the original terms of reference.

Early in its Alaskan program, Beak explored the range of expected biological impacts due to regulation of river flows using models developed from literature and limited field studies. Fig. 3 shows the six models employed. It quickly became apparent that until the physical processes in the lower river, estuary and offshore were known, along with their expected changes due to regulation, there could be no meaningful impact analyses. Consequently, from the fall of 1980 to early 1982, Beak concentrated on identifying the anticipated physical changes in the Stikine, but at the same time conducted related studies to add to the biological data base. The remainder

of this section describes the major physical and biological studies completed during this time.

(a) Physical Studies

Preliminary work suggested four major physical effects of the impoundment on the river:

1. changes in the salinity distribution in the estuary due to the regulated flows being somewhat lower than natural flows in summer, and considerably higher in winter;

2. changes ir the degree and frequency of water level changes on the floodplain;

3. changes in the sedimentation rate of the delta due primarily to the entrapment of sediment in the reservoirs;

4. changes in the delta micro-climate, in particular changes in river icing regime induced by a change in river temperature.

Studies undertaken to address these issues included:

1. measurements of salinity distribution throughout the estuary, at various river discharges and tides;

2. measurements of currents at a variety of locations, principally in the intertidal region of the estuary;

3. measurements of suspended sediment concentration and water flow at the USGS gauge near Wrangell and at the North Arm/South Arm divide;

4. measurements of suspended sediment concentration and flow in the major distributaries of the lower estuary;

5. measurements of meteorological parameters over the winter of 1980/81;

6. surface and core samples of sediment in the intertidal part of the delta;

7. a survey of the delta edge;

8. surveying a test reach composed of four cross-sections across the floodplain and main channel.

To assist with the evaluation of impacts, B. C. Hydro provided preliminary information on hydrology which included data on stage/flow, water temperatures, sediment transport, water quality, and theoretical operational regimes.

(b) Biological Studies

Biological studies included investigations of productivity, marsh and foreshore production and fish.

(i) Productivity Investigations

A model of plankton productivity was developed to increase understanding of the processes affecting biological production offshore of the Stikine delta. A transition zone between the extremely turbid water near the river's mouth and the clearer offshore water was modelled because this zone is considered to be an important source of food for juvenile fish entering and rearing in the estuary.

(ii) Marsh and Foreshore Production Studies

Floodplain and delta vegetation of the Stikine River was classified and mapped to determine:

- the extent of plant communities directly influenced by river water at various times of the year;
- the contribution of stream-side plant communities to the food cycles;
- how stream-side plant communities would be influenced by changes to the physical system;
- the natural stability of vegetation communit es over the last 50 years.

(iii) Fisheries Studies

A number of potential fish or fish habitat impacts were identified in preliminary impact assessments. These included:

- reduction of the spring plankton populations, reducing food availability for pink, chum and chinook fry, larval eulachon and starry flounder in offshore habitats;
- reduction in side channel and backwater flooding, reducing rearing habitat for coho and chinook juveniles;
- erosion of the delta, affecting rearing habitat for starry flounder, chum and chinook juveniles.

Because of the economic importance of the fish resources on the Stikine River, fisheries studies undertaken in 1980, 1981 and especially 1982 have investigated the distribution of fish species in major habitat areas, specifically:

- offshore habitats;
- mud and sand flats on the delta;
- brackish marshes;
- floodplain.

3.0 INTERIM CONCLUSIONS

There are seven major interim conclusions of estuary and floodplain studies to date.

1. Regulated river flows and water levels would likely be higher in winter and lower in summer than natural flows. Summer peak floods in May, June and July would likely be reduced in magnitude and frequency but fall peaks would be almost unaffected.

2. Sediment supply to the delta probably would be reduced.

3. There likely would be no significant changes in water movement and salt content in the delta.

4. Although the river would be slightly warmer in winter, the warming effect would likely be small compared to the cooling effect of the Stikine outflow winds. Any changes relative to river icing would be expected to be minor.

5. Flooding of the upriver floodplain would probably diminish. This might affect the area available for fish habitat and eventually change the type of stream-side vegetation.

6. The structure of the delta would likely not be extensively altered. Oceanographic forces do not appear strong enough to cause significant erosion.

7. Substantial numbers of juvenile salmon and starry flounders rear in estuarine and brackish water marsh areas; however, the relatively minor changes predicted for these habitats suggest little or no impact is likely.

4.0 CURRENT AND FUTURE STUDIES

Field studies in Alaska for 1982 are concentrating on clarification of the expected impacts. A detailed B.C. Hydro measurement program is under way in the lower Stikine River near the Iskut River confluence to provide estimates of the annual suspended sediment supply to the estuary. The program will also investigate the grain size distribution of the suspended sediment and identify sediment contributions from the glacial tributaries in the lower river.

Beak's 1982 field program involves mapping and characterization of important fish habitats in the floodplain and estuary. Eulachon as well as commercially important salmon rearing and spawning habitats are under investigation.

Assuming that B. C. Hydro's studies are to be completed in 1984, the field season of 1983 would provide an additional opportunity to expand our data base on the Alaskan side of the border. It is expected that more fisheries studies would be undertaken at that time. Floodplain wildlife and delta waterfowl studies may also be expanded during this field season.

5.0 SHARING INFORMATION WITH ALASKA

(a) Past Communication Activities

B. C. Hydro began sharing Stikine-Iskut information with Alaska on an informal basis in 1979, including participating in public meetings, and will continue to do so throughout all phases of

planning for the development. It continues to be B. C. Hydro's normal procedure to release technical reports to the public after they have been reviewed. Table 1 lists the B. C. Hydro reports on the estuary and fisheries which have been informally transmitted to Alaskan government agencies since 1981.

(b) B. C.-Alaska Information Exchange Committee

While informal discussions between B. C. Hydro and Alaska have been occurring over the last few years, the formal commitment to share information on the Stikine-Iskut hydroelectric and other developments was made in May 1982 when the B. C.-Alaska Information Exchange Agreement was signed by Governor Hammond and Premier Bennett. The B. C.-Alaska Information Exchange Committee, which was established under the terms of the Agreement, will exchange all available information pertinent to the hydroelectric development. At the first meeting of the committee, a technical sub-committee was formed involving representatives from Alaska Fish and Game Department, USDA Forest Service, B. C. Ministry of the Environment, Canadian Department of Fisheries and Oceans and B. C. Hydro. The purpose of the sub-committee is to meet on a more frequent basis than the main committee and exchange technical information at the working level.

(c) Scheduled Public Meetings

The next meeting of the B. C.-Alaska Information Exchange Committee is planned for November or December 1982. B. C. Hydro will also hold public meetings in Wrangell, Petersburg and Juneau. At the public meetings, B. C. Hydro specialists and their consultants will present information on the proposed developments and be available to answer questions.

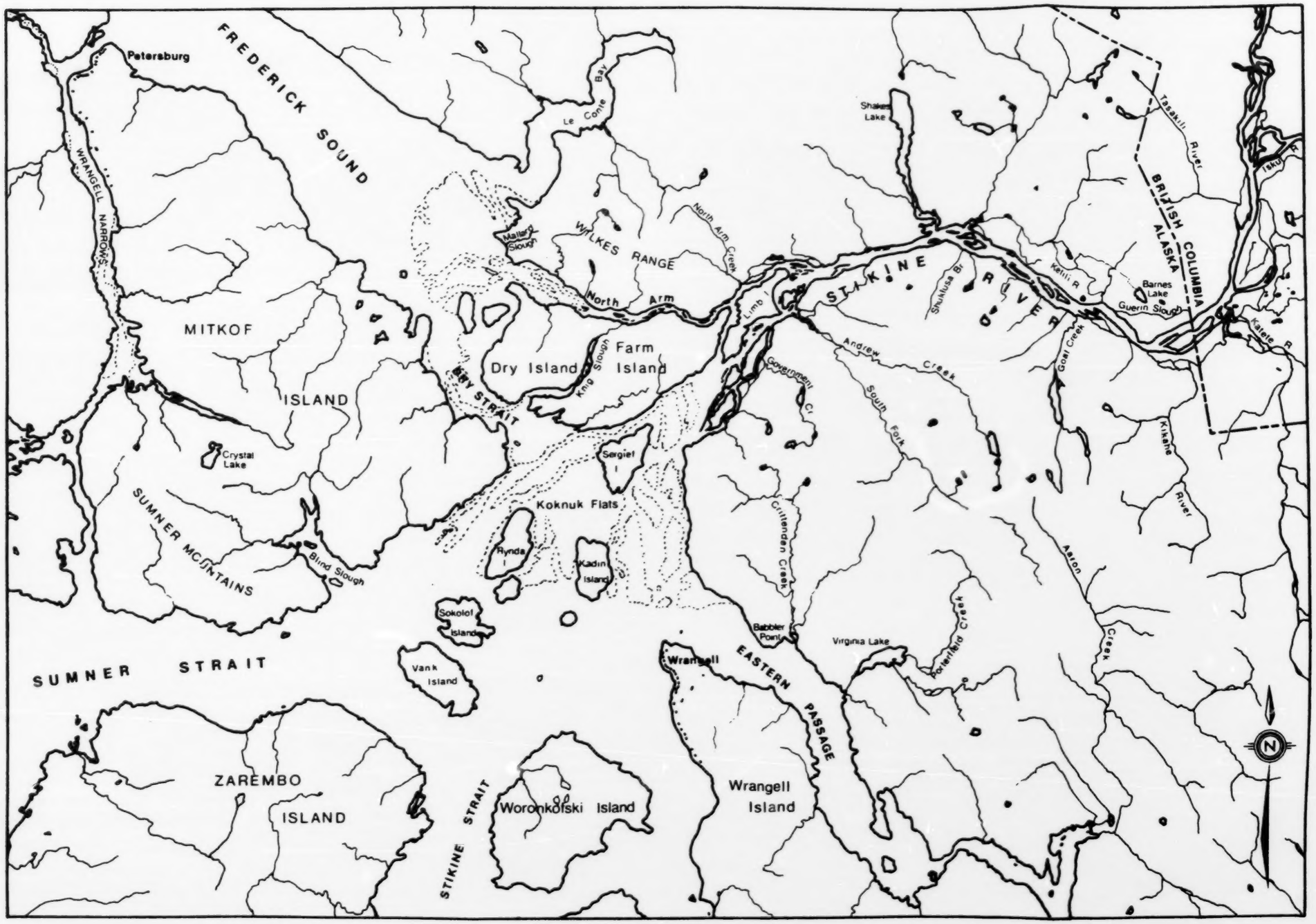

FIGURE 1 **The Lower Stikine River and Estuary**

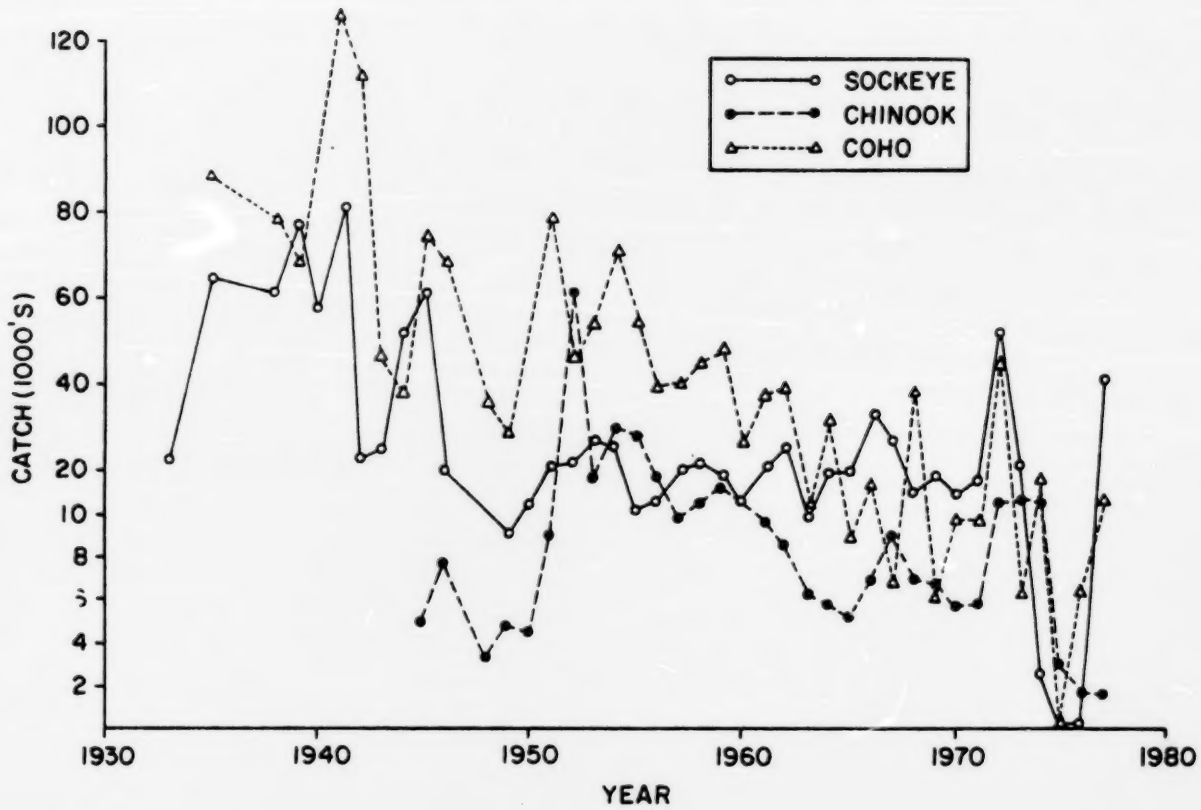

Figure 2: Commercial catches of three major species of salmon, 1933-1977, Stikine District, Alaska.

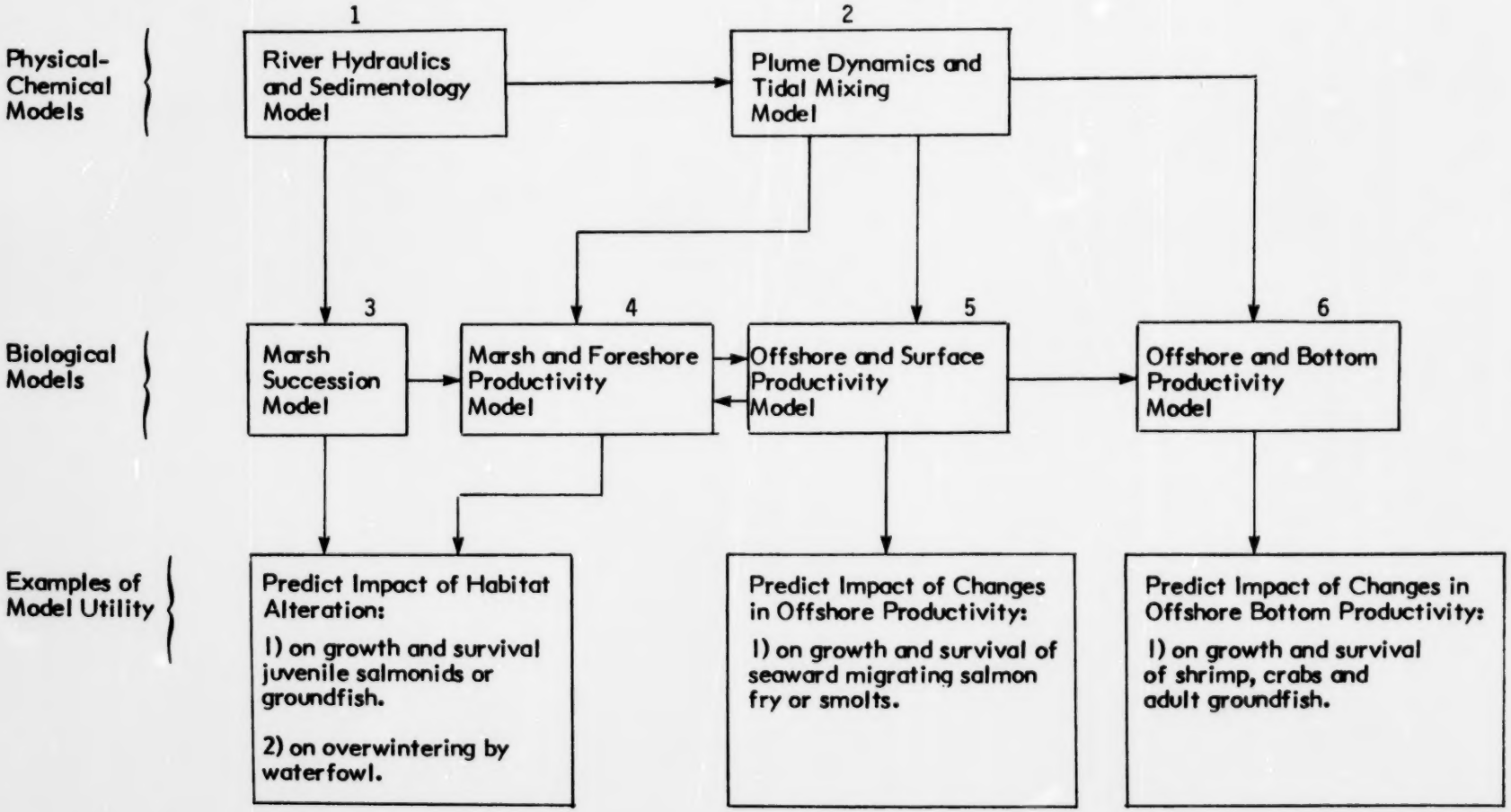
Physical-Chemical Models
Biological Models
Examples of Model Utility
1
River Hydraulics and Sedimentology Model
2
Plume Dynamics and Tidal Mixing Model
3
Marsh Succession Model
4
Marsh and Foreshore Productivity Model
5
Offshore and Surface Productivity Model
6
Offshore and Bottom Productivity Model
Predict Impact of Habitat Alteration:
1) on growth and survival juvenile salmonids or groundfish.
2) on overwintering by waterfowl.
Predict Impact of Changes in Offshore Productivity:
1) on growth and survival of seaward migrating salmon fry or smolts.
Predict Impact of Changes in Offshore Bottom Productivity:
1) on growth and survival of shrimp, crabs and adult groundfish.

FIGURE 3: Sub-Models Required for Impact Predictions on the Stikine-Iskut Estuary Project.

TABLE 1

STIKINE-ISKUT HYDROELECTRIC DEVELOPMENT ENVIRONMENTAL REPORTS TRANSMITTED TO U. S. AGENCIES

1. Stikine Estuary Report
   (Beak Consultants, September 1981)

2. Data Reports on Fisheries Studies 1979 to 1981
   (Beak Consultants, February 1980, January 1981 and February 1982)

3. Stikine-Iskut Hydrology - Report H1110
   (B. C. Hydro, October 1981)

4. Stikine-Iskut Fisheries Studies 1979
   (McCart et al, April 1980)

5. Stikine-Iskut Hydroelectric Development Progress Report on Feasibility Studies
   (B. C. Hydro, December 1980)

6. A Background Study of Available Knowledge - The Lower Stikine River and Estuary, Alaska
   (Schultz International, 1979)